ANGLER HARVEST SURVEY

PINE LAKE 2009

Prepared by:

Nathan Millar and Lars Jessup

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Copies available from:

Yukon Department of Environment
Fish and Wildlife Branch, V-5A
Box 2703, Whitehorse, Yukon Y1A 2C6
Phone (867) 667-5721, Fax (867) 393-6263
E-mail: environmentyukon@gov.yk.ca

Also available online at www.env.gov.yk.ca

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Key Findings

- Anglers spent 1,185 hours of angling effort on Pine Lake in the summer of 2009. At 2.2 hours of angling per hectare, this angling effort for a Yukon lake is very high.
- Angler success, as measured by the number of lake trout caught per hour of angling, was below the average of other Yukon fisheries surveyed to date.
- The estimated Optimal Sustainable Yield (OSY) for lake trout in Pine Lake is only 69 kg. In 2002, harvest greatly exceeded OSY (171 kg). Sustained overharvest can reduce OSY to below 69 kg.
- In 2009 we estimated harvest to be 47 kg of lake trout. This is a minimum estimate because it does not include several other unquantified harvests like First Nations subsistence, winter ice fishing, and open-water fishing outside of the survey period.
- High levels of angling pressure, low success, past overharvest, and a small population all point to the lake trout stock in Pine Lake being depleted.

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Introduction

We conduct angler harvest surveys, also called creel surveys, on a number of Yukon recreational fisheries each year. We use these surveys, together with other fish and fishery-related assessments, to find out if the harvest of fish from the lake is sustainable. Environment Yukon tries to conduct angler harvest surveys on key fisheries either every 5 years or according to angler patterns and management concerns. The results of the surveys directly contribute to management decisions that make sure fisheries are sustainable over the long term.

Pine Lake is in the southwest Yukon within the traditional territory of the Champagne and Aishihik First Nation. It is a small, shallow lake with an area of 548 hectares (5.48 km^2) and a mean depth of 14.7 m. It is located at the base of Paint Mountain along the Alaska Highway, 6 km northeast of Haines Junction. The lake is primarily accessed through the government boat launch at Pine Lake campground. A road crosses Pine Creek and runs along the west side of the lake connecting a number of houses and cabins to the community. There is another smaller boat launch along this road. Pine Lake supports populations of lake trout, lake whitefish, northern pike, burbot, and slimy sculpin.

The angler harvest has been surveyed on two previous occasions: 1990 and 2002. In 2009 Pine Lake was chosen for surveying because of its local importance and high level of use.

The survey was done to:

- determine how much time anglers spent fishing (effort);
- understand the fishery's characteristics and patterns of use;
- measure the success rate of anglers;
- compare the level of harvest to the productive capacity of the lake;
- record biological information on harvested fish;
- provide anglers with information about regulations; and
- establish a fisheries management presence.

Harvest Regulations

Pine Lake has been managed as a Special Management Water since 2004. Regulations protect declining or depressed stocks or species of interest. Only barbless hooks are permitted. The catch limit for lake trout is one fish per day and all fish over 65 cm must be released. The possession limit is also one fish. For Arctic grayling, the catch limit is 2 fish per day and all fish over 40 cm must be released. The possession limit for grayling is 2 fish. For northern pike, the catch limit is 4 fish per day and all fish over 75 cm must be released. The possession limit is 4 fish. General catch and possession limits apply to all other species. Appendix 1 shows the regulation history for Pine Lake.

Methods

Survey

In 1990 the Yukon Government adopted survey methodology developed by the Ontario Ministry of Natural Resources (Lester and Trippel 1985). A field worker conducts face-to-face interviews with anglers on selected sample days throughout the summer. The worker asks a standard set of questions about the social and biological aspects of the fishery. Data gathered include:

- How much time did anglers spend fishing?
- What fishing methods did anglers use?
- How did anglers fish (boat, shore, etc.)?
- Were anglers guided?
- Where were anglers from?
- What type of visitor were anglers (day users, campers, etc.)?
- What kinds of fish were anglers trying to catch?
- How many fish did anglers catch?
- How many fish did anglers release?

Any other information offered by anglers about their fishing experience is also recorded.

The field worker also collects biological data on the catch of cooperative anglers. Biological data gathered include: length (mm), mass (g), sex, maturity, an aging structure, as well as the collection of stomachs for content analysis in the lab. Any other information about general health and condition of the fish is recorded by the field worker (e.g., abnormalities, disease, lesions).

The field worker subjectively assesses the weather's effect on fishing over the entire sample day (no possible adverse effect, possible adverse effect, definite adverse effect).

The timing of the survey depends on management objectives, key species, and the nature of the fishery. It typically runs from ice out in the spring until either just after Labour Day or the end of September. The goal is to sample at least 20% of the total survey days. The survey is subdivided into several seasonal periods (usually 3 or 4) to better understand changes in angler activity. These periods are further divided into weekends and weekdays. Sample days are allocated to each period while considering both a higher weighting for those periods with the higher projected angler use and a minimum number of samples for each period.

Sample days are 14 hours long, 8:00AM to 10:00PM. On sample days, the field worker interviews all willing anglers. The field worker also records anglers who are observed but not interviewed.

Analysis

When the survey is finished, the data are entered into an Access database and analyzed using standard statistical methods. The age of sampled fish is determined by counting growth rings on the otolith (a small bone from the fish's head). Diet is determined by examining the stomach contents.

Lake Productivity

The productivity of a lake determines the amount of fish produced annually and can guide how much harvest can be sustained. Estimates of lake productivity are calculated using average lake depth, the concentration of total dissolved solids, and the average annual air temperature at the lake. Ryder's morphoedaphic index (1974) is used and incorporated into Schlesinger and Regier's equation (1982) for calculation of maximum sustained yield (MSY) for all species. Calculation of MSY for lake trout assumes a biomass of 30% lake trout; where appropriate this may be replaced by the most recent survey data. Following O'Connor (1982) and others, 15% of MSY provides an "optimum" sustained yield (OSY), which maintains high quality fisheries on light to moderately fished lakes.

2009 Pine Lake Survey

The survey began May 18 and ended on September 7, 2009.

We used an access survey methodology. The field worker was stationed at the campground and boat launch at the southwest end of the lake (Figure 1) for the whole of each sample day. The worker interviewed angling parties at the end of their fishing trips. Previous surveys and local knowledge suggest that most anglers reach Pine Lake from this location.

Figure 1. Pine Lake, showing location of 2009 Angler Harvest Survey (*).

The survey period was divided into 6 time periods: weekends and weekdays in May/June, July, and August/September (see Appendix 1 for results broken down by period). During the 112-day survey period, 33 days were sampled, giving a sampling effort of 30%. All data were analyzed at the party level.

Results of the 2009 Survey

Effort

We estimate that 1,185 hours of angler effort (fishing time) were spent on Pine Lake over the 2009 survey period. This is 2.2 hours of angling effort per hectare. Altogether, 562 anglers fished on Pine Lake for an average of 2.1 hours per angler. Fishing occurred for an average of 10.6 hours each day.

Fishing Methods

Trolling was the most popular method of fishing, followed by spin casting (Table 1). No other methods of fishing were observed.

Table 1. Fishing methods, Pine Lake 2009.

Method of Fishing	Percent of Angler Parties
Still	
Jig	
Drift	
Troll	62%
Spin Cast	38%
Fly Cast	
Other or Combination	

Methods of Access

Most anglers used motorboats, with some anglers fishing from shore (Table 2). A few anglers used canoes and rowboats.

Table 2. Angler access methods, Pine Lake 2009.

Access Method	Percent of Angler Parties
Canoe	2%
Rowboat	2%
Motorboat	76%
Shore	20%
Other	

Guided Anglers

All the formally guided anglers (a slightly higher than average percentage) were clients of Lee Drummond's Paddle/Wheel Adventures (Table 3). It operates out of Haines Junction, mainly guiding guests with Holland America Line tours.

Table 3. Guided anglers, Pine Lake 2009.

Anglers	Percent of Angler Parties
Guided	22%
Not guided	78%

Angler Origin

Most anglers were from Whitehorse and Haines Junction, followed by American anglers, then other Canadian residents (Table 4).

Table 4. Angler origin, Pine Lake 2009.

Origin	Percent of Angler Parties
Local (Haines Junction)	44%
Whitehorse	44%
Yukon	
Canada	4%
U.S.	8%
Other	

Visitor Type

The majority of anglers were day users, followed by government campground users (Table 5). Other categories were relatively small or non-existent.

Table 5. Angler visitor type, Pine Lake 2009.

User Type	Percent of Angler Parties
Day users	58%
Camper – Territorial campground	38%
Camper – Private campground	4%
Camper – Crown land	

Weather

Weather did not appear to have an adverse effect on angling. Most days showed no possible adverse effect on angling (Table 6).

Table 6. Sample day weather, Pine Lake 2009.

Did Weather Affect Angling?	Percent of Angler Parties
No possible adverse effect	84%
Possible adverse effect	16%
Definite adverse effect	

Targeted Species

Anglers targeting a particular species were more successful than those who did not (Table 7). Lake trout data were the most notable in this category. Although only 46% of anglers specifically targeted lake trout, those anglers were

responsible for 97% of the lake trout catch and 88% of the lake trout harvest. Twenty-six percent of anglers targeted northern pike and were responsible for 78% of the catch and 100% of the harvest. Only one group of anglers targeting northern pike harvested a lake trout.

Table 7. Catch and harvest by anglers targeting specific species, Pine Lake 2009.

Species	Percent of Angler Parties	Percent of Total Catch	Percent of Total Harvest
Lake trout	46%	97%	88%
Northern pike	28%	78%	100%

Catch and Harvest

Retention rates for lake trout were low (25%). An estimated 28 lake trout were harvested in 2009 (Table 8). Northern pike were the most caught fish, but only 21 (5% of the catch) were harvested. No other species were caught or harvested.

Table 8. Angler catch and harvest, Pine Lake 2009.

Species	# Caught	# Kept	Retention Rate
Lake trout	104	28	27%
Northern pike	405	21	5%

Estimated angler success rates, calculated over the entire survey as numbers of fish caught per hour of angling effort (CPUE), is presented for all anglers (regardless of target species) in Table 9.

Table 9. Estimated catch per unit of effort (CPUE; fish/ hour), Pine Lake 2009.

Species	CPUE
Lake trout	0.09
Northern pike	0.34

Biological Data

Only 6 lake trout were sampled for biological data. This sample size is not large enough for meaningful conclusions and so these data are not reported here. All data are housed in the Yukon Department of Environment database.

Comparison with Previous Surveys

We completed previous angler harvest surveys in 1990 and 2002. The 2002 survey was similar in methodology and design and is directly comparable with the 2009 survey. The 1990 survey was based on fewer sample days and some comparative data are not available. Comparisons to the 1990 results should be done with this in mind.

Effort

Estimated summer open water angler effort was slightly higher (17%) in 2009 compared to 2002 (Table 10).

Table 10. Total estimated angler hours, Pine Lake 2009, compared to 2002 and 1990.

	2009	2002	1990
Hours	1,185	1,012	373

Fishing Methods

Fishing methods have remained consistent since 2002. Trolling and spin casting are the most common (Table 11).

Table 11. Fishing methods (percent of angler parties), Pine Lake 2009, compared to 2002 and 1990.

Method	2009	2002	1990
Still		1%	
Jig			
Drift		1%	
Troll	62%	55%	N/A
Spin Cast	38%	33%	
Fly Cast		2%	
Other or Combination		8%	

Methods of Access

Most anglers use motorboats (Table 12). Between 2002 and 2009 the proportion of anglers fishing from shore increased, while the proportion of anglers fishing from canoes decreased.

Table 12. Methods of access (percent of angler parties), Pine Lake 2009 compared to 2002.

Access	2009	2002	1990
Canoe	2%	28%	
Rowboat	2%	2%	
Motorboat	76%	64%	N/A
Shore	20%	4%	
Other		2%	

Guided Anglers

Formally guided parties have increased from 3% in 2002 to 22% in 2009 (Table 13). This large increase can be attributed to Holland America Line's guided tours, which started between the 2002 and 2009 surveys.

Table 13. Guided anglers (percent of angler parties), Pine Lake 2009 compared to 2002.

Party	2009	2002	1990
Guided	22%	3%	N/A
Not guided	78%	97%	

Angler Origin

The proportion of local anglers (from Haines Junction) has increased, while there are slightly fewer anglers from Whitehorse (Table 14). The number of American anglers has increased because of the guided clients from the Holland America Line tours. Note that the 1990 data grouped all Yukoners, whether from Whitehorse or from elsewhere in the Yukon, into a single category.

Table 14. Origin of anglers (percent of angler parties), Pine Lake 2009, compared to 2002 and 1990.

Origin	2009	2002	1990
Local	44%	27%	
Whitehorse	44%	52%	
Yukon		1%	84%
Non-resident Canadians	4%	15%	2%
U.S.	8%	2%	
Other		3%	14%

Visitor Type

Most anglers have been day users in all survey years (Table 15). Government campground users are the next largest group. There are a few records of visitors camping at private campgrounds or on Crown land. These data were not collected in 1990.

Table 15. Visitor type (percent of angler parties), Pine Lake 2009 compared to 2002.

Type	2009	2002	1990
Day users	58%	56%	N/A
Camper – Territorial campground	38%	44%	
Camper – Private campground	4%		
Camper – Crown land			

Weather

The field worker subjectively evaluates the effects of the weather on fishing. The data indicate that most days were good for fishing in 2002 and 2009 (Table 16). Weather data were not collected in 1990.

Table 16. Weather effects on angling activity (percent of angler parties), Pine Lake 2009 compared to 2002.

Did Weather Effect Angling?	2009	2002	1990
No possible adverse effect	84%	63%	N/A
Possible adverse effect	16%	33%	
Definite adverse effect		4%	

Catch and Harvest

Though effort did not change significantly, the catch of lake trout in 2009 was much lower than it was in 2002 (Table 17). The harvest was also much lower, partly because of reduced catch, but also because of a reduced retention rate. The increase in guided parties accounts for some of this change because guided clients usually release all the fish they catch unless the fish is hooked very badly and unlikely to survive.

Other factors may have contributed to the declining harvest of lake trout. Regulations introduced in 2004/2005 reduced catch and possession limits and established maximum size limits for Arctic grayling, lake trout, and northern pike. These restrictions may have also forced or encouraged anglers to release fish. The creel contractor also reported that local anglers were not fishing as much because the fish were much smaller than they used to be.

Northern pike catches have increased with each survey. However, because the retention rate decreased as catch went up, the harvest has remained low and steady since the first survey in 1990.

Arctic grayling and lake whitefish catches were only recorded in the 2002 survey. Neither species were caught in large numbers and are therefore not included in the table. Only one record exists for each species. According to one report, grayling were more plentiful in the lake until the 1970s, when work on the outlet culvert resulted in a higher lake level.

Table 17. Estimated number of fish caught, fish kept and the retention rate, Pine Lake 2009, compared to 2002 and 1990.

Species	Retention	2009	2002	1990
Lake trout	Caught	104	263	10
	Kept	28	142	10
	Released	76	121	0
	% Kept	27	54	100
Northern pike	Caught	405	189	41
	Kept	21	56	19
	Released	384	133	22
	% Kept	5	30	46

Estimated angler catch per unit effort (CPUE, the number of fish per angler hour) over the entire survey can reflect changes in the fishery because it incorporates effort and catch. Dramatic decreases in CPUE for a particular species could indicate problems of health or status. However, relying on CPUE of anglers alone is not recommended (see the section entitled "Invisible Collapse" in *Status of Yukon Fisheries 2010* [Environment Yukon, 2010]). Anglers are very good at finding fish even when the population is in decline.

In Pine Lake, lake trout CPUE was low in 1990, then increased greatly in 2006, only to drop again in 2009 (Table 18). Lake trout CPUE on Pine Lake is currently below the Yukon average for lakes surveyed to date (Yukon average is 0.13 for the most recent survey on each lake).

Table 18. Estimated catch per unit of effort (CPUE; fish/hour), Pine Lake 2009, compared to 2002 and 1990.

Species	2009	2002	1990
Lake trout	0.09	0.26	0.03
Northern pike	0.34	0.19	0.11

Northern pike CPUE has steadily increased over surveys, probably because of the larger number of anglers specifically targeting northern pike in 2009 (up from 13% to 28%).

Fishery Sustainability

We estimate that Pine Lake could sustain a total annual lake trout harvest of about 69 kg (see Methods - *Lake Productivity*). Estimates of sustainable yield are imprecise, so we attempt to minimize risk and maintain fishery quality by using conservative estimates. The estimated sustainable yield for Pine Lake is low, suggesting that the population is very vulnerable to overharvest.

Anglers harvested 28 lake trout from Pine Lake over the summer (Table 19). Total fish mortality (death) includes the unintentional mortality of any released fish. Catch and release, when done properly, has a minimal impact. Lake trout survival rates range from 93% for lightly handled fish to 76% for deep-hooked fish (YFWMB 1998). We used an average of 85% survival. For the 76 lake trout released in 2009, this results in an additional mortality of 11 fish for a total of 39 fish. Based on the average size of harvested fish, the weight of total lake trout mortality in the recreational fishery was 47 kg. We consider this a minimum, because harvests from the open water fishery outside of the period of this survey, from the ice fishery, and the First Nations subsistence fishery are not included. No information is currently available on these fisheries.

Table 19. Estimated summer lake trout harvest by anglers, Pine Lake 2009, compared to 2002 and 1990.

Harvested by Anglers	2009	2002	1990
Lake Trout Harvest	28	142	10
Number Released	76	121	0
Catch and Release Mortality (15%)	11	18	0
Total Harvest & Mortality	39	160	10
Mean Weight (kg)	1.20	1.07	1.14
Total Harvest & Mortality (kg)	47	171	11

The minimum estimate of fishing harvest and mortality in 2009 (47 kg) was lower than the optimal sustainable limit, estimated at 69 kg. Because of data gaps for other harvests (subsistence, ice fishing, and open water fishing outside the survey period), we cannot confidently conclude that total harvest is less than the optimal sustainable limit.

Further, our estimate of productivity assumes that the fish population is healthy. If a fish population is depleted (i.e., a reduced stock size), then the productivity of the population will be lower until the population has recovered. We believe this to be the case in Pine Lake for several reasons. First, the lake

trout harvest in past years has exceeded sustainable levels (e.g., in 2002). Second, recent surveys of lake trout indicate a very small population (Jessup and Millar 2011). Third, the low success rates of anglers suggest that the lake trout population in Pine Lake is depleted.

The combination of reduced lake trout productivity (due to a small or depleted population) and uncertainties in the total harvest, points to a potential continued overharvest of lake trout in Pine Lake. The results of this survey and results of recent fisheries assessments suggest lake trout in Pine Lake are depleted, or at least that the population is very small. Depleted populations require the focus and attention of management and monitoring efforts. We therefore recommend carrying out an angler harvest survey and a fish population assessment within 5 years. Information on ice fishing and the size of the First Nation subsistence fishery should also be collected in the next survey. Estimates of harvest in the open water fishery outside of the survey period should also be considered.

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Appendix 1. Pine Lake angling regulations, 1989 to 2009.

Year	Species	Catch limit	Possession limit	Size restrictions
1989/90*			General Regulations	
	Lake trout	3	6	Only one fish over 80 cm
	Arctic grayling	5	10	none
	Northern pike	5	10	none
	Whitefish	5	10	none
1991/92			General Regulations	
	Lake trout	3	6	Only one fish over 65 cm
	Arctic grayling	5	10	Only one fish over 40 cm
	Northern pike	5	10	Only one fish over 75 cm
	Whitefish	5	10	none
2004/05			Special Management Water	
	Lake trout	1	1	Release all fish over 65 cm
	Arctic grayling	2	2	Release all fish over 40 cm
	Northern pike	4	4	Release all fish over 75 cm

* Yukon Government obtained responsibility for freshwater fisheries management from the Federal Government in 1989.

Appendix 2. 2009 Pine Lake angler harvest survey results: Comparisons between periods.

Effort

Mean daily angler effort on weekends was highest in May/June with substantial drops occurring after each month (Figure 2.1). Weekday effort was abnormally high in July but was very low in May/June and August/September. Weekend effort at Pine Lake was more consistent with a typical pattern in Yukon lake trout fisheries.

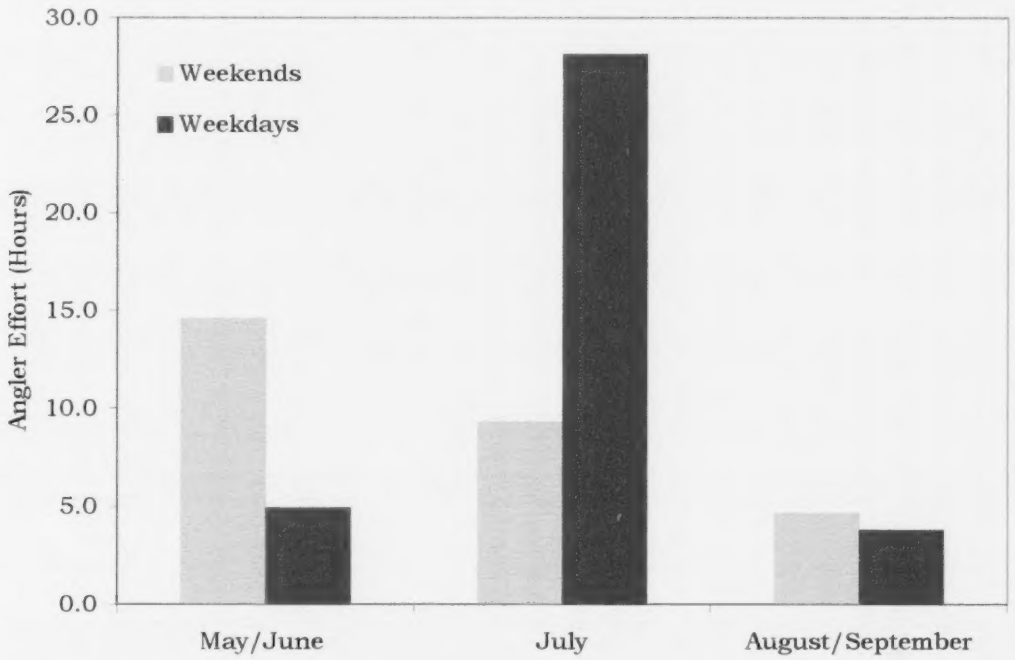

Figure 2.1. Estimated angler effort per day.

Catch

Lake trout CPUE was fairly low all summer but was at its highest in May/June. Northern pike CPUE was very low in May/June but increased throughout the season, especially when the vegetation started growing around the shores in July. Northern pike CPUE increased each month and was highest in August/September (Table 2.1).

Catch per unit effort patterns for lake trout are consistent with typical Yukon summer patterns. Success is high in the spring following ice out and then drops as water temperature warms. Fall increases are usually related to

onset of spawning and cooling water temperatures. These fluctuations are not dramatic on Pine Lake as CPUE remained consistently low over the summer.

Table 2.1. Estimated catch per unit of effort (fish/hour) by period.

Period	Lake trout	Northern pike
Late May/June weekends	0.30	0.07
Late May/June weekdays	0.14	0.07
July weekends	0.08	0.19
July weekdays	0.02	0.51
August/ early September weekends		0.70
August/ early September weekdays	0.14	0.72